Abstract Report of

NORTHERN CALIFORNIA

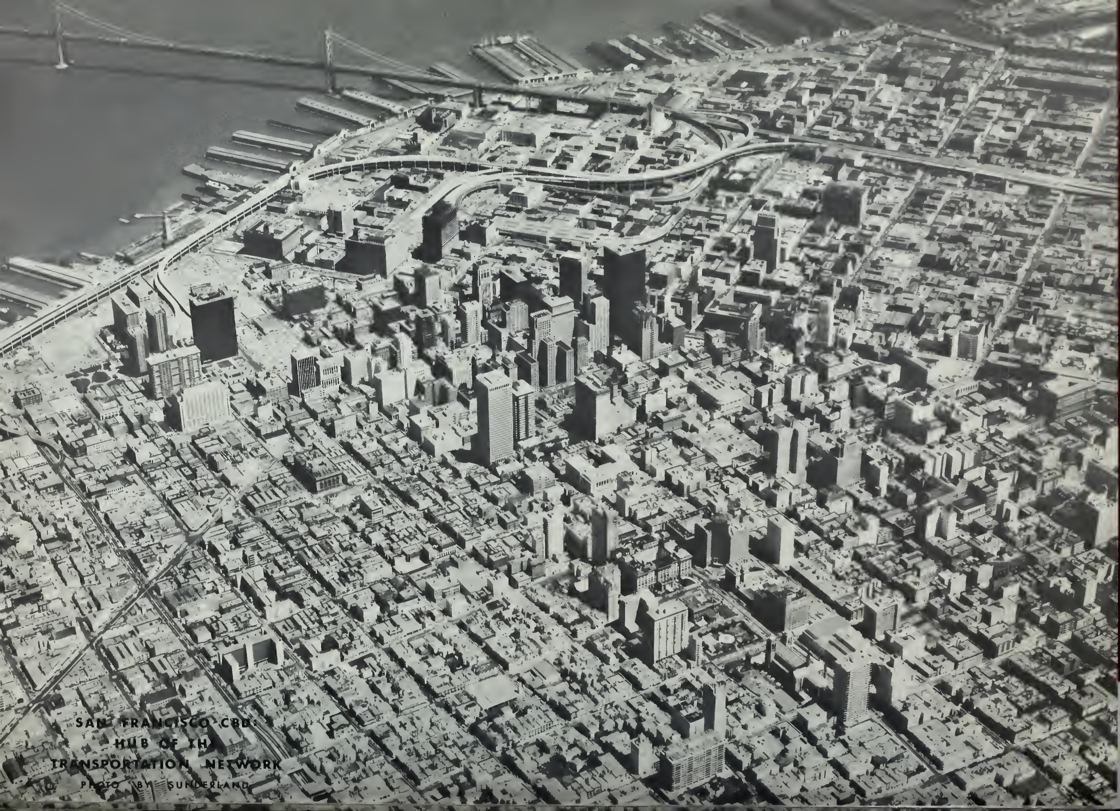
TRANSIT DEMONSTRATION PROJECT

COORDINATED TRANSIT FOR THE SAN FRANCISCO BAY AREA — NOW TO 1975

Cal MTD-5 and Cal MTD-6

October 1967

PREPARED BY SIMPSON & CURTIN — TRANSPORTATION ENGINEERS — PHILADELPHIA & SAN FRANCISCO



SAN FRANCISCO CBD:
HUB OF THE
TRANSPORTATION NETWORK
PHOTO BY SUNDERLAND

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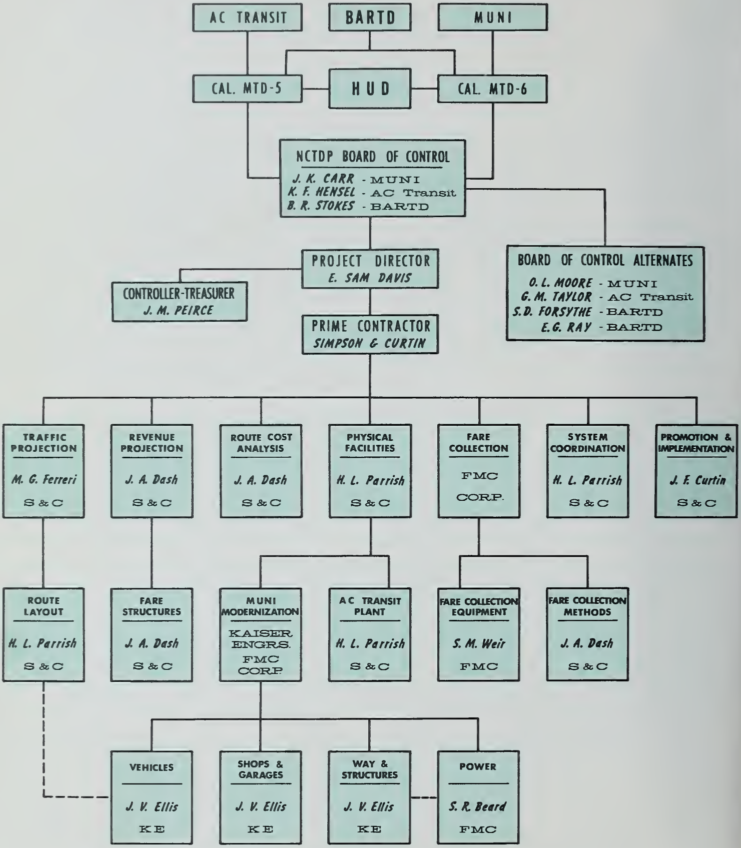
ORGANIZATION OF

NORTHERN CALIFORNIA TRANSIT DEMONSTRATION PROJECT



REPORT IN BRIEF

INTRODUCTION . . . Chapter 1

THE RUGGED TOPOGRAPHY which makes San Francisco a picturesque city is also the reason underlying its reliance upon transit. Within the city proper, steep grades on the numerous hills are a deterrent to auto travel. Suburban communities are separated from the central city by San Francisco Bay and by mountains, limiting access to its two world-famed bridges and a few land gateways to the south. These topographical barriers and the city's residential density (31 persons per acre) combine to make San Francisco highly dependent upon public transportation; per capita transit use is second only to New York and substantially greater than Chicago and Philadelphia, although both latter cities have vast rapid transit networks.

Study Area—The travel habits of over two million people are involved in the Northern California Transit Demonstration Project study area, blanketing the three transit systems under consideration:

- The City of San Francisco, all of which is served by its municipal railway (Muni);
- Portions of Alameda and Contra Costa Counties served directly by AC Transit;
- Daly City and other communities in northern San Mateo County served by either Muni or Greyhound commuter routes;
- Areas in Alameda and Contra Costa Counties within range of AC Transit or Greyhound commuter routes.

Service territory of the Bay Area Rapid Transit District (BARTD) is conterminous with this study area.

Study area population is projected to reach 2¾ million persons by 1975. The bulk of this will occur in the sparsely developed sections—southern Alameda County, eastern Contra Costa County and portions of northern San Mateo County. In anticipation of this, study boundaries were extended beyond service limits of existing transit systems.

San Francisco is a compact, fully developed city with a residential population of 755,000 and daytime population in excess of one million. Downtown San Francisco is the center of commercial, retail and civic activities—not only the hub of the entire Bay Area but the principal financial, shopping and commercial center for the prosperous West Coast.

The East Bay area divides into two major geographical sections separated by Berkeley Hills, (1) a coastal plain of over a dozen incorporated cities and towns strung together in a 40-mile north-south chain three to eight miles wide, and (2) a broad valley east of the hills which includes Lafayette, Walnut Creek, Pleasant Hill, Concord and other communities.

Surface Transit Systems—Muni is a city-owned transit operation with 61 surface routes providing extensive coverage throughout San Francisco. It carries 409,000 adult passengers daily, more than half of whom board or alight in the CBD, and utilizes over 900 vehicles in four types of service—streetcars, electric trolley coaches, motor buses and cable cars.

PRINCIPAL TRANSIT CARRIER serving East Bay communities is Alameda-Contra Costa Transit District (AC Transit). This operation accommodates a million people in a string of communities—Oakland, Berkeley, Alameda, etc.—adjoining San Francisco Bay from San Pablo to Hayward. Local service is provided, as well as arterial routes between them. AC Transit also operates a substantial transbay service over the Bay Bridge to a downtown San Francisco terminal. 240 motor coaches are used in transbay service, accommodating 36,500 passengers daily. In the East Bay, AC Transit uses another 330 motor vehicles furnishing 49,000 miles of service for 90,000 adult riders daily.

Regional Rapid Transit—Construction is under way on the Bay Area's new 75-mile rail rapid transit system. BARTD is notable on several counts: it is the first brand new transit venture in this auto-oriented country in half a century; 61% of local taxpayers voted for a $792 million bond obligation to launch the system; its conceptual development features high-speed travel and passenger amenities in a forthright appeal to lure commuters out of automobiles. Operation of BARTD is scheduled to begin on the East Bay in 1969, with the balance of the system completed by 1971. BARTD will be underground for most of its length in San Francisco, across the Bay and in Berkeley; some sections will operate on aerial structure, with remaining portions on restricted right-of-way at grade.

In San Francisco, the BARTD line will serve the CBD along its principal axis under Market Street, continue through the Mission district to the southwestern part, terminating in Daly City. On the East Bay side, three lines are being built outward from downtown Oakland—one north to Richmond, another east to Concord and the third line south to Fremont.

The system is being developed for maximum rider appeal, with high-speed operation, automatic train control, attractive trains and stations, etc. BARTD stations will have average spacing of two miles to accommodate speeds of 40-50 m.p.h.; speed in the transbay leg will run up to 80 m.p.h.

Systems Analysis—A new technology in transportation planning has emerged in recent years through development of an interdisciplinary systems approach, similar to methods of operations research used in space and other advanced sciences. The socio-economic factors influencing transportation are correlated into mathematical models, then tested by simulation procedures. In areawide transportation studies, this systems approach is proving effective in coping with the growing complexity of forecasting consequences of alternative policies, thus furnishing effective planning insight to decision-makers.

Not only is there a growing understanding of future transportation alternatives in terms of probabilities, but this systems approach also makes it evident that substantial influence may be exerted over these probabilities. In other words, the transportation future is no longer vague and unforeseeable, but inevitable; instead, there are a variety of alternative futures, with related probabilities, which can be reasonably forecast—and to some degree, manipulated.

The basic approach is that transportation embraces a comprehensive system of interrelated activities, involving adaptation of transportation facilities, spatial organization of land and human activities, demographic and social characteristics as well as consumer choices in determining transportation modes. Some of these are grouped into transit system characteristics—route locations, operating speed, headways and fares; others are rider characteristics such as trip origin and destination, travel purpose and auto ownership, while the third groups of factors governing transportation are land use characteristics—residential density, employment, commercial activity, etc.

The task has been to develop reliable measures of these variables for the Bay Area, preliminary to drawing correlations between them and segregating those having a measurable effect on transit usage. With existing relationships established and validated, mathematical models are designed to simulate growth characteristics of the Bay Area, reflecting the future travel distribution. Alternative layouts of rapid and surface transit systems are then developed and tested by superimposing the matrix of travel desires on each route to furnish a 'loaded' network.

THE TWO MODELS developed for plan evaluation—combination fare model and cost allocation model—are among the more significant contributions of NCTDP to systems analysis in the transit planning process. By these techniques, various layouts for Muni and AC Transit have been coordinated first between traffic and routes, then between costs and fares, and this iterative process repeated until the raison d'etre of the project has been accomplished—optimum transit service in the Bay Area by 1975.

BAY AREA TRAVEL MARKET

PRESENT TRANSIT TRAVEL ... Chapter 2

A composite picture of transit travel in the Bay Area was developed by quizzing one-quarter million transit riders for details of their riding habits. This O/D survey revealed significant findings on the 535,000 adult riders in the Bay Area on the average 1965 weekday—41,600 of whom traveled transbay, 93,600 in the East Bay and 399,500 in San Francisco and peninsula communities.

Transbay Service—Buses are only 3% of transbay traffic, yet they transport 45% of transbay workers and shoppers to downtown San Francisco in peak periods.

The four principal East Bay cities—Oakland, Berkeley, Alameda and Richmond—generate over 20,000 transit rides daily to and from the San Francisco CBD. Oakland is the largest single production area, originating 9,800 transbay journeys. Altogether, there are 27,040 trips daily on AC Transit and Greyhound vehicles from East Bay communities to downtown San Francisco—the flow pattern of which corresponds to the BARTD alignment.

San Francisco CBD attracts more East Bay riders than the Oakland CBD—27,040 compared to 23,200. However, over three times as many riders shop in downtown Oakland as cross the Bay on shopping trips.

Over 20% of transbay riders use automobiles to get to their boarding stops. On Muni and AC Transit local lines, only 5% and 6% of riders, respectively, either drive or are driven. It is significant that this additional portion of transbay riders—15% more than local transit users—use automobiles to reach the buses, yet choose not to drive all the way to San Francisco. It suggests that, to the extent a coordinated BARTD-Muni-AC Transit system will improve the speed, comfort and convenience of transit riding, more automobile drivers can be influenced to switch to transit.

East Bay Transit Travel—Downtown Oakland attracts nearly 25% of AC Transit's local travel from East Bay communities on the average weekday. Six out of 10 riders to the Oakland CBD start within Oakland itself. Another one out of 10 begins from Berkeley, while one more travels from Alameda. These communities have frequent and direct service so that more than 80% of riders bound for Oakland CBD complete their journeys on one vehicle without having to transfer. Automobile use as a means of reaching the local bus is more pronounced percentagewise in communities farthest from the Oakland CBD—Castro Valley, Hayward, Richmond and San Leandro.

Transit Travel in San Francisco is predominantly CBD-oriented; 209,000 Muni passengers enter and leave downtown San Francisco daily.

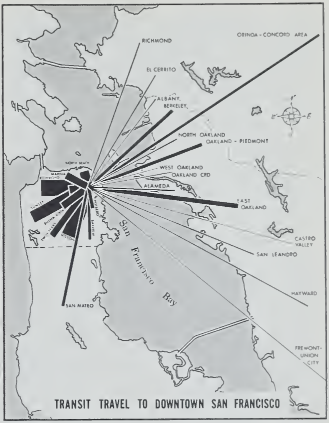
Walking is the dominant travel means to and from Muni service, reflecting widespread and convenient area coverage. Fewer than one out of three riders transfers to a second vehicle to complete his journey.

WITHIN SAN FRANCISCO, travel from the Richmond district accounts for more trips (33,378) to downtown than any other residential district. Other major corridors to downtown are Sunset (24,482) and Mission (28,746) districts. The latter will be served well by BARTD.

Home-to-work travel accounts for the majority of transit rides in virtually all classes of service. Eight out of 10 transbay riders are making work-related trips; the remaining 20% are distributed among shopping, personal business, social-recreational and other activities. On Muni streetcars and buses, seven out of 10 riders are traveling between home and work; about 8% are shoppers, while another 11% are on personal business trips. Few riders use transit for social-recreational travel; the major exceptions are cable car lines, particularly Mason and Hyde Street routes, where 25%-30% of patrons are tourists.

Auto Ownership and Availability—More than two-thirds of AC Transit riders are 'captive,' i.e., they do not have an automobile available for trips by transit. 38% do not own a car and another 30% do not have one available for transit journeys.

Among transbay riders, approximately 50% own and have available at least one automobile for the journey but they use AC Transit buses instead, demonstrating the ability of fast and attractive transit service to draw commuters even when they have an option of auto use.



TRANSIT TRAVEL TO DOWNTOWN SAN FRANCISCO

PRESENT HIGHWAY TRAVEL . . . Chapter 3

Auto travel is by far the dominant means of transportation in the Bay Area and will continue in that role for the foreseeable future. In assessing transit's future market, it was necessary to define total travel activity not only in terms of transit but also the use and supply of highway facilities. Planning data from the California Division of Highways, adapted to the 474 NCTDP study zones, were used for these trip generation and distribution computer programs.

The busiest single facility in the Bay Area is the San Francisco-Oakland Bay Bridge. This double-decked facility carries 130,000 vehicles daily. The Golden Gate Bridge, connecting San Francisco with Marin County, carries 70,000 vehicles a day. Major routes across the southern limit of San Francisco accommodate 172,000 vehicles entering and leaving the city daily.

Over 70% of downtown San Francisco travel is by auto and taxi. Transit access is gaining slowly, although it represents only 27% of the total downtown movement. But the efficiency of transit is revealed in the evening peak period—4:30 to 5:30 P.M.; streetcars and buses carry almost half the persons moving yet represent only 2% of vehicles on downtown streets.

The San Francisco CBD is the area of maximum interest for potential travel divertible to future transit improvements. Transbay vehicular trips to downtown San Francisco amount to 33,570 daily—36% of the total transbay volume terminating in the NCTDP study area. Similarly, major desire lines of auto travel within San Francisco converge upon its downtown area, accounting for 353,180 vehicular trips daily.

Travel time ratios, i.e., travel time via transit in relation to highways, were determined for every pair of zones in the 474-zone study area to assess transit's comparative attractiveness. Trips to the employment hub (Montgomery and California Streets) indicate travel time ratios from 0.5 to 3.5; in other words, there are some zones where transit is twice as fast as the automobile and others where auto travel is 3½ times as fast as transit.

For travel to the CBD, transit now holds its own or is faster than autos from 15% of the 172 zones in San Francisco. With a five-minute travel time improvement, the number of zones where transit would have the time advantage over autos would be doubled, bringing 30% of San Francisco zones into the range of transit travel time advantage. This analysis is particularly valuable in pointing out the locations where improvements in speed and quality of transit service could have competitive impact.

EXISTING TRANSIT SERVICE . . . Chapter 4

Muni operates four types of vehicles—cable cars, streetcars, trolley coaches and motor buses—in three functional categories of service: arterial routes serving the CBD; crosstown lines and feeder routes. System revenue is just under 75¢ per mile. The weakness in placing reliance upon this unit value is revealed in the cable car operation; its fare receipts aggregate $2.74 per mile, yet the cable car lines are the greatest losers in the system.

Muni's level of service, patronage and productivity have remained unusually constant in recent years. There have been no fare increases, no new equipment, no mileage increases or decreases and virtually no change in patronage levels. Nine measures of regular route operations show less than 2% variation between 1960 and 1965. Meanwhile, over the same period, surface transit systems throughout the country had an aggregate passenger decline of 15.2%, mileage drop of 7.9% and decrease in passengers per mile of 8.1%.

AC Transit is an all-bus operation composed of two major services—transbay and East Bay. The 12 transbay lines account for nearly one-third of system mileage and slightly over one-fifth of passenger traffic. Due to longer rides and higher fares, however, transbay routes produce nearly 40% of system revenue.

Appreciable increases have occurred in patronage and amount of service on AC Transit since the Transit District took over operations of the Key System in late 1960. Transbay mileage rose 13% between 1961 and 1965, while East Bay service increased 12%. As result, revenue passengers carried and passenger revenue have gained substantially. The revenue rise was 18% on the 12 transbay lines, and about half that on East Bay service. On East Bay arterial and crosstown lines, the gain in passengers and revenue was less than the mileage increase, with the result that unit revenue dropped.

Muni Operating and Plant Facilities—For the most part, present Muni facilities are outmoded, inadequate and overdue for replacement. Rolling stock consists of 1,028 revenue vehicles and 96 service cars and trucks. It includes 75 White gasoline buses, 449 Mack diesels, 360 trolley coaches of various manufacture, 105 PCC streetcars (most of which are secondhand) and 39 cable cars dating from 1893.

Muni's maintenance facilities comprise six operating divisions and three overhaul shops. Vehicle needs and maintenance facilities are summarized as follows:

- All facilities are exceptionally crowded, causing double shifts, interference with housekeeping and cleaning of vehicles and unnecessary transfer of maintenance and storage between divisions. Lack of yard space has caused numerous instances of body damage, further straining the limited body shop facilities.
- High maintenance on the buses' power, trains and brake linings due to severe grades imposes a double load on maintenance facilities.
- Space requirements for transit equipment are critical; any cutbacks for BARTD or city facilities at Muni's expense will only jeapordize further the system's low performance capability.
- Outmoded vehicles—White buses, PCC cars and trolley coaches—require Muni to provide maintenance through cannibalization, or manufacturing parts through expensive castings and/or machining.

AC Transit Operating and Plant Facilities—By contrast, AC Transit has a comparatively modern fleet and plant facilities. Rolling stock consists of 685 diesel coaches, 400 of which have been acquired since 1960. 112 buses are air-conditioned.

AC Transit vehicles are maintained at three operating divisions—Richmond, Emeryville and East Oakland. These operating and maintenance depots have been modified in recent years in step with overall growth of the Transit District. They are well equipped with modern maintenance and service facilities and entirely adequate for the AC Transit fleet.

PRESENT FARE SYSTEMS . . . Chapter 5

Fares are probably the most sensitive aspect of a transit service, representing a balance between political considerations and need for operating revenues. In the Bay Area, this sensitivity is evident in both Muni and AC Transit; despite continual operating deficits, both systems have held to obviously low fares for several years.

Muni has one of the lowest and simplest transit fare plans in the nation—a citywide 15¢ fare for adults, 5¢ for children and students, free transfers, no tokens and no zones. This fare has been in effect since 1952.

AC Transit has zone fares, but the first zone is so large as to approach an areawide flat fare plan. More than 80% of East Bay journeys are one-zone rides. The basic adult fare is 25¢ with a 20¢ token rate. Zone increments for the four additional zones are 5¢ and 10¢ each. Transbay fare between the central East Bay zone and downtown San Francisco is 50¢ cash or 45¢ on a commute ticket.

Greyhound provides extensive suburban commuter service in the Bay Area. Compared with Muni and AC Transit, its fares are higher and more extensively zoned. The minimum Greyhound fare is 30¢; cash fares run up to $1.15 between San Francisco and more distant points in the NCTDP study area. Greyhound offers monthly commutation tickets between San Francisco and East Bay communities, and 20-ride commute books between San Francisco and peninsula communities.

Combination Fares—There are no joint fare arrangements between Muni and AC Transit. O-D studies reveal a substantial interchange of passengers between the two, particularly at the San Francisco Transbay Terminal. Combination fares for multi-vehicle journeys between systems will become particularly significant when BARTD is superimposed on them.

Among the 22 largest metropolitan areas in the country, only Philadelphia and Washington have combination fare arrangements between suburban and local transit systems to any significant degree. In both cities, joint fare tickets are sold by drivers manually; neither the sale nor collection is automated.

PRESENT TRANSIT COSTS . . . Chapter 6

A pioneer effort has been made in this study to develop an appropriate measure for projection of future costs among Bay Area transit systems by design of a cost allocation model reflecting amount of service, operating speed, trip length and other service parameters in individual route performance. As a first step, the trend of major cost elements on the Muni and AC Transit systems was analyzed for recent years to determine normalized cost levels and rate of change. Thereafter, the allocation model was developed to serve as a basis for apportionment of expenses to individual routes and to evaluate unit cost variations induced by major route changes, as contemplated in subsequent network proposals.

Aggregate operating costs for Muni system in 1965 amounted to $1.057 per mile for all types of service. Substantial variation existed among the several classes; bus operations required 93.1¢ compared with $1.045 per mile for trolley coach, $1.15 for streetcar and $4.966 for cable car operations. Two adverse factors in the cable car cost picture are two-man operation and average speed of 4.6 m.p.h.

AC Transit's system unit cost was 64¢ per mile in 1965. Despite an increasing mileage base for spreading fixed costs, unit expenses have been rising at an average rate of nearly 4% for several years.

Cost Allocation—Five elements of primary value have been identified in allocating expense items: vehicle hours, vehicle miles, peak vehicle needs, miles of line and passenger revenue. Wages is the largest single item of expense; since operating and maintenance employees are paid on an hourly basis, vehicle hours of service provide the best measure of this item. Certain other costs, such as power or fuel, tires, equipment maintenance and items involving wear, are related directly to miles of operation on each route. On the other hand, storage facilities for vehicles is a function of number of vehicles required to operate a line, rather than miles or hours of service. Similarly, expenses in servicing vehicles—fueling, cleaning, washing, etc.—are more nearly a function of number of vehicles than any other variable. Way and structures expenses for track and power service are related to length of line. And, finally, accident costs and claims expense are related generally to line revenues throughout the industry.

Cost formulas for four classes of Muni service were derived:

Streetcar: $C = 6.328H + 0.31691M + 7{,}412V + 2{,}478L + 0.11792R$

Cable Car: $C = 11.058H + 1.608M + 11{,}859V + 4{,}969L + 0.19624R$

Trolley Coach: $C = 6.108H + 0.16978M + 7{,}000V + 404L + 0.09462R$

Bus: $C = 6.359H + 0.15755M + 7{,}420V + 155L + 0.11456R$

San Francisco Convention
& Visitors Bureau

Where: C = Average annual cost of operation
H = Vehicle hours
M = Vehicle miles
V = Morning or evening peak vehicles
L = Length of line in miles
R = Route revenue in dollars

A similar analysis of AC Transit operating experience normalized and updated to 1967 cost levels yielded the following formula:

Bus: $C = 6.209H + 0.11089M + 5{,}788V + 0.03865R$

These formulas were used for analyzing current services by Muni and AC Transit, particularly in determining the margin between operating revenues and expenses for arterial routes, feeder lines, transbay routes, East Bay express and local lines, etc.

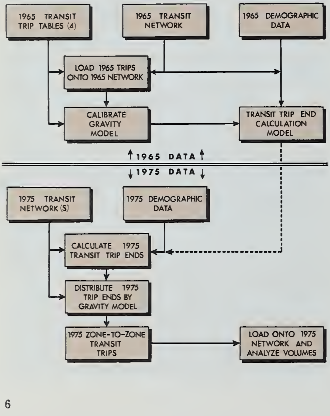
OPERATING RESULTS IN 1965 . . . Chapter 7

Both existing local transit systems in the Bay Area had substantial deficits in 1965. Muni collected $19,904,816 in operating revenues and spent $27,966,377 without depreciation, leaving an operating loss of $8,061,561. Muni has been regularly running deficits in a range of $5 to $10 million annually since 1960.

In operating ratio terms, operating costs were above revenues by 33% on streetcars, 78% on cable cars, 22% on trolley coaches and 53% on bus routes.

Operating results for AC Transit in 1965 were somewhat more favorable, but they also totaled to a system deficit of $1,463,421. Operating revenue aggregated $13,363,691, while cost of service amounted to $14,827,112. Transbay service was a profitable operation; the excess of revenues over operating costs on the 12 transbay lines was $670,000—15% of transbay revenues. On East Bay arterial routes, there was a deficiency of $940,000 (14%), while crosstown lines failed to meet costs by $245,000 (72%). Feeder operations of AC Transit lost well over $1 million, with costs running approximately 214% of operating revenues.

TRANSIT TRAVEL ESTIMATING PROCESS


1965 TRANSIT TRIP TABLES (4)
1965 TRANSIT NETWORK
1965 DEMOGRAPHIC DATA
LOAD 1965 TRIPS ONTO 1965 NETWORK
CALIBRATE GRAVITY MODEL
TRANSIT TRIP END CALCULATION MODEL
1965 DATA
1975 DATA
1975 TRANSIT NETWORK (S)
1975 DEMOGRAPHIC DATA
CALCULATE 1975 TRANSIT TRIP ENDS
DISTRIBUTE 1975 TRIP ENDS BY GRAVITY MODEL
1975 ZONE-TO-ZONE TRANSIT TRIPS
LOAD ONTO 1975 NETWORK AND ANALYZE VOLUMES

Like its West Bay counterpart, AC Transit has been managed as a deficit operation, with partial reliance on tax proceeds, since its conversion to a publicly owned system in 1960. Supplementary receipts from local taxation have increased steadily from $445,000 in 1961 to $2,345,000 in 1966.

Subject to various restrictions and limitations, Muni and AC Transit have access to tax proceeds, not only for capital funds, but for operating and maintenance expenses as well. The same is true for BARTD to a limited degree. For the most part, communities in the Bay Area have been ahead of the rest of the country in recognizing that supplementary transit revenues from general taxes and other sources are a sound community investment in encouraging greater patronage of public transportation. Recent developments in New York City, Boston and Pennsylvania, as well as enactments by Congress, indicate a growing awareness of the value of good transit service, reasonably priced and supported where necessary by revenue from non-transit sources.

TRAVEL RELATIONSHIPS . . . Chapter 8

The transit industry has long recognized and quantified the impact of factors affecting riding, particularly as related to transit service itself. Formulas for measuring the effect of fare increases or service reductions upon transit patronage are in regular use. In addition, there are variables known to affect transit use, outside the purview of management. These relate to characteristics of transit patrons and land use.

Rider characteristics include the diversity of socioeconomic factors pertaining to the needs and aspirations of people in moving from place to place. One reflection of the desire for higher living standards is the rise in auto usage over the past two decades. The third group of factors affecting transit riding involves land use characteristics; each land use activity—central city commercial, residential, industrial, etc.—generates or attracts travel flow of a particular nature and magnitude.

Fifty-two variables were tested for their possible influence upon transit tripmaking. Certain of these were discarded due to difficulty in expressing accurate measurement or inability to forecast them with confidence; others were dropped for low correlation with transit use. Stepwise multiple correlation through use of high-speed electronic computers was the principal technique in drawing correlations among remaining variables. For each class of transit traffic, a mathematical expression was developed among the significant variables—a transit use model—which became the basic tool for evaluating results of altering the framework within which the present transportation network functions.

Transit Use Model—The estimating technique developed in this study differs from modal split models prepared by other areawide transportation studies in its basic concept. The modal split methodology generally develops the total travel market by calibrating trip generation of total person trips, then splitting this market into transit and auto segments. This assumes a constant pool of trips generated by land use and person characteristics, which remains the same regardless of what type of transit system is planned—only the modal split changes. Under the approach developed in this study, each segment of the travel market is independently derived from characteristics of tripmakers, land use and system factors. By this method, the total pool of trips varies under different systems, as well as the split between transit and auto usage. Greater statistical validity from an in-depth transit O-D survey enabled NCTDP to develop estimating equations by which transit trips were derived directly rather than as a percentage of total travel.

Twelve trip estimating equations were developed to express the relationships among variables influencing three basic categories of travel—home-based-work, home-based-non-work, and non-home-based. These three trip purpose categories involve separate equations for trip production and trip attraction, separated between San Francisco zones and remainder of the Bay Area. The latter stratification was necessary by reason of significant differences in transit use characteristics within the city proper compared with travel within the East Bay and other sections on the peninsula. These 12 equations were made up of the following independent variables and their combinations as applied to each of the 474 NCTDP zones.

1. Population
2. Employment
3. Automobiles owned
4. Gross population density
5. Median family income
6. Weekday miles of transit service
7. Service density measured by transit miles per acre
8. Transit travel time from each zone to downtown Oakland and downtown San Francisco
9. Auto travel time from each zone to downtown Oakland and downtown San Francisco
10. Composite peak hour headways in minutes
11. Composite off-peak hour headways in minutes
12. Employment density in jobs per acre
13. Number of transit seats on weekday schedule

After the models for trip production and attraction were developed, another model was devised for distributing trips between zones. This phase of the estimating process was adapted from the gravity model, used widely in areawide transportation studies.

Accuracy checks were made throughout the estimation process as a test of the system's ability to reproduce present day travel as it occurs 'on the street.' Comparisons between Muni maximum load points around the San Francisco CBD and estimated volumes from the 1965 simulation network showed the network link data to be 0.04% more than the Muni cordon count. With this degree of estimating accuracy, the models were deemed sufficiently fine-tuned for route planning.

POPULATION AND ECONOMIC GROWTH . . . Chapter 9

The vigor with which the Bay Area continues to grow provides the substance upon which future estimates of transit use are founded—anticipated people and jobs in 1975. With nearly three million people currently, the San Francisco-Oakland metropolitan area is the nation's seventh largest population center. More significantly, it is one of the fastest growing among the top metropolitan areas in the country.

NCTDP study area population is estimated to increase 20% by 1975. Most of this will occur in the sparse areas of the East Bay; San Francisco will increase only 4% in the decade 1965-1975.

Projection of San Francisco population to reach 785,000 by 1975 is based upon an evaluation of prior projections, the city's Community Renewal Program and extrapolation of the 1960-65 growth rate.

San Francisco Employment Projections—The State Employment Department reveals a steady growth in jobs within San Francisco over the past 20 years—averaging 3,670 jobs annually since 1955. Based on this and projected modifications by the State Employment Department, a total city employment of 513,000 is estimated for 1975.

Downtown San Francisco is experiencing a construction boom in office buildings—more than one million square feet added in 1965 alone, bringing the city's downtown office space to nearly 20 million square feet. The CBD accommodated 282,000 jobs in 1965—58% of San Francisco's total employment. Another 19,000 jobs will be available by 1975, bringing CBD job attractions to over 300,000. This will represent nearly two-thirds of the total job gain throughout San Francisco in the 10-year span from 1965 to 1975.

From a transportation standpoint, it is important to recognize that while San Francisco's population growth rate is estimated at 4% over this decade, the rate of increase for downtown employment will be nearly twice that—reflecting not only the employment attraction beyond city limits but the increasing demand for improved regional transit facilities.

Alameda County—Communities in Alameda County within the study area will grow 19%, or nearly 200,000 persons, in the 10-year period 1965-1975. Three-quarters of this gain will occur in the southern portion—in the less intensely developed communities such as Fremont, Newark, Union City, etc.

Oakland is the largest city in Alameda County and also the most fully developed. A projected increase of 14,400 residents, less than 4%, is expected by 1975; most of this is expected in the eastern hilly portion and the southern section of the city.

Berkeley is another fully developed community in the East Bay, particularly around the University of California campus, where densities range up to 30 persons per acre. It will grow only slightly in the next decade 'by its own choice.'

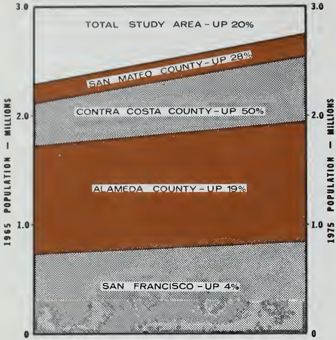
Employment in the study area section of Alameda County totaled 365,280 jobs in 1965. Differential rates of employment growth follow the pattern of population increases to the extent that the upper portion of the county currently accounts for 85% of total jobs.

Jobs are projected to increase by 68,500 in the 10-year span to 1975. Almost one-half of this will occur in the undeveloped southern portion. These projections were developed with heavy reliance on data supplied by the Alameda County Planning Department for five community labor markets defined by the California Department of Employment.

Contra Costa County—The part of Contra Costa County within the NCTDP study area is split by the Berkeley Hills into two sub-areas for analysis purposes. The Richmond-San Pablo area had a population of 168,072 in 1965; this is projected to increase to 210,000 by 1975. Throughout this area, population densities range between 10 and 20 persons per acre, except for a few zones of heavier density in Richmond and San Pablo proper.

With respect to employment, relatively heavy increases—in excess of 30%—are forecast for parts of

NCTDP STUDY AREA POPULATION GROWTH 1965 – 1975



Richmond. Job gains in excess of 10% are projected for San Pablo, El Cerrito and the remainder of Richmond.

The 1965 population of eastern Contra Costa County was 215,800. This is projected to reach 363,600 by 1975 —a rise of 68%. Except for a portion of Concord, population density throughout this area is less than 10 persons per acre. Even with a projected rise of more than two-thirds it will remain comparatively sparse in 1975.

Eastern Contra Costa County is destined to continue primarily residential. Jobs will rise as communities develop in size, but at less than one-half the rate of population growth. An overall increase in employment of 30% is projected for the 1965-1975 period, matching the 68% rise in population.

FUTURE TRAVEL MARKET

TRANSIT TRAVEL IN 1975 . . . Chapter 10

Prospective transit travel involves two primary considerations: (1) the anticipated volume of passengers using surface and rapid transit service, and (2) the layout of routes to accommodate this anticipated riding. Under the systems approach utilized in this study, coordinated transit network and trip generation models permitted simultaneous testing of a complete set of route configurations with each system analysis. In a typical test run, all 120 (or more) surface transit routes, as well as the rapid transit lines, were laid out to match anticipated travel desires. This produced a test network which then was coded for machine simulation and 'loaded' with the future origin-destination travel matrix to reflect the resulting use of each transit route in that system.

To limit the number of alternatives, a testing program was devised for bracketing the ultimate solution by first testing extreme possibilities, then refining between them. In the case of AC Transit, two basic network philosophies were first evaluated. In one test, no changes were made in AC Transit transbay and East Bay express routes, except that the BARTD alignment was superimposed on them. This was tried to assess the impact of BARTD and point out the routes which could not withstand competitive BARTD service. The other extreme for AC Transit operations was analyzed in the second run; all transbay and East Bay express lines were eliminated, while arterial, crosstown and feeder lines were rerouted to stations to facilitate transfer to BARTD.

Similar bracketing was used in the San Francisco layouts by first testing a rapid transit 'feeder' plan, then analyzing a 'through route' plan, stressing the advantages of one-vehicle service. While neither of the extreme networks was wholly acceptable, these alternatives quickly pointed up the significant aspects of each. Succeeding proposals then were tested for each system by linking the favorable alternatives developed from prior test runs. Five complete transit networks were developed for the AC Transit system and four such arrangements for Muni before the recommended plans were finally determined. When the computers indicated that further network refinements would not produce higher transit volumes or faster travel, the optimum future transit system in the Bay Area was accomplished.

1975 Transit Market—The Bay Area transit market is estimated to increase from 534,731 adult trips daily in 1965 to a new pool of 673,109 adult trips in 1975, before fare adjustments. If school children are added, the projected market for transit at the three-quarter century mark will be 812,000.

Principal factors underlying this 26% transit gain expected over 10 years are the addition of BARTD and a supplementary three-part Muni rapid transit system in San Francisco. Population growth is also a factor, but its effect is primarily to offset the prevailing diversion of transit riders to automobiles. In the 1955-1965 decade, transit riding declined in the Bay Area notwithstanding a 20% population increase.

Transbay travel will attract the largest share of increased transit usage; an 81% increase from 41,600 to 75,244 adult trips daily in 1975 is projected. All of this gain, as well as most present transit riders crossing the Bay, will be on BARTD. AC Transit system is expected to continue in transbay service, but at a much reduced level. Compared with a daily level of 33,540 AC Transit transbay patrons in 1965, the traffic estimation process foresees only 3,640 bus riders over the Bay Bridge daily in 1975—a drop of nearly 90%. In addition, all Greyhound patronage from Contra Costa County to San Francisco—more than 8,000 riders daily —will be diverted to BARTD.

For trips wholly within the East Bay, the impact of BARTD is not expected to be as severe on AC Transit. Total East Bay adult journeys are projected to rise from 93,627 to 110,450 daily in 1975, an 18% gain. BARTD will divide this market with AC Transit on an approximately equal basis. While it will lose a significant share of arterial travel, AC Transit will more than offset this by picking up a high proportion of feeder trips to BARTD stations for both East Bay and transbay journeys. The net result will be an overall gain of 12% in passengers handled by AC Transit, but for trips of considerably shorter length.

BAY AREA AVERAGE WEEKDAY ADULT TRANSIT TRIPS
1965—1975
(Prior to Adjustment for Fare Differentials)

	1965	1975	% Change
TRANSBAY			
AC Transit	33,541	3,640	
Greyhound	8,054	—	
BARTD	—	71,604	
Total	41,595	75,244	+80.9%
EAST BAY			
AC Transit	91,719	53,845	
Greyhound	1,908	—	
BARTD	—	56,605	
Total	93,627	110,450	+18.0%
SAN FRANCISCO—WEST BAY			
Muni Surface	382,188	154,428	
Muni Rapid	—	198,949	
BARTD	—	113,080	
Greyhound	17,321	20,958	
Total	399,509	487,415	+22.0%
TOTAL	543,731	673,109	+25.9%

The impact of BARTD on the Muni system is not expected to be as great. San Francisco adult journeys are forecast to rise from 399,509 to 487,415 daily in 1975, a 22% overall gain. BARTD will share this market with Muni, but the latter is expected to retain about three-fourths of it. Even with this lesser proportion, however, San Francisco will be the prime market for BARTD riding due to its greater aggregate volume. Many surface route volumes will drop significantly, but Muni will offset this decline with new rapid transit riding and also by gaining feeder trips to BARTD stations.

BARTD Riding in 1975—The dominant transit attraction throughout the Bay Area in 1975 will be BARTD. To a considerable degree, optimizing transit use in the area means optimizing use of BARTD; this is the principle followed in developing the coordinated route plan. The result is that nearly one out of three transit trips in 1975 will use BARTD for at least part of the journey.

BARTD has potential 1975 ADT of over 253,000 riders—29% in transbay travel, 24% locally in East Bay and the remaining 47% within San Francisco. Maximum accumulation on BARTD will occur on Market Street in downtown San Francisco between Civic Center and Powell Street Stations.

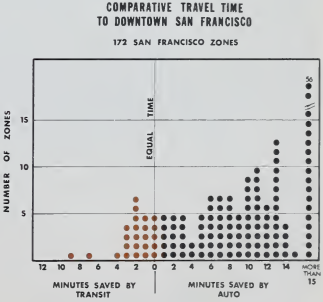
Montgomery Street will be the most heavily used BARTD station, with over 116,000 passengers boarding and alighting daily.

A substantial share of BARTD traffic will come from present auto users, under the NCTDP trip forecasting procedure. 32.3% of BARTD travelers in the East Bay will be diverted from automobiles; in transbay service, BARTD will draw 30.3% of its patronage from motorists crossing the Bay Bridge. These estimates represent a higher proportion of transit diversion from auto travel than any rapid transit facility has been able to attract heretofore. Yonge Street Subway in Toronto drew 12.9% of its patronage from former auto users, while the two newer rapid transit systems in Chicago—Congress Street Rapid and Skokie Swift—were able to divert 12.5% and 17.5% respectively. With high operating speeds and distinctive passenger amenities, BARTD is expected to be twice as effective as these other rapid transit developments in luring motorists out of automobiles.

The most significant impact of BARTD will be upon San Francisco-Oakland Bay Bridge. 21,000 transbay auto-person trips will be diverted daily to BARTD in 1975. In terms of peak hour usage, this amounts to 3,200 vehicles in the peak hour/direction—more than two lanes of auto travel. Coupled with the fact that 80% of transbay buses will also be diverted, net effect of BARTD will be to add three peak hour/direction lanes to present bridge capacity.

The foregoing calculation does not take into account the fact that AC Transit now provides four lanes of transit patronage in both the morning and evening peaks. BARTD will assimilate nearly 90% of this volume and, in addition, divert more than two lanes of auto travel to subway movement. Its overall effect, therefore, will be the equivalent of seven transbay lanes in the peak hour/peak direction. In terms of equivalent capacity, BARTD will be equal to another Bay Bridge in delivering East Bay citizens to downtown San Francisco each morning.

Recommended AC Transit Network—Under Plan E —the recommended route layout for AC Transit—30 of the 65 present routes are modified to feed BARTD, two are changed for reasons unrelated to BARTD, 21 remain unchanged, 12 are eliminated, and one new route is added. Six transbay routes are proposed for continued operation, but on a much reduced basis. With these six lines reduced by more than 50% in volume and elimination of the remaining 10 transbay lines, AC Transit travel will be cut to 5% of the transbay market. Two East Bay express routes are retained in the recommended plan; the remaining five are eliminated.


COMPARATIVE TRAVEL TIME TO DOWNTOWN SAN FRANCISCO

172 SAN FRANCISCO ZONES

Transit now has a time advantage in only 15% of San Francisco zones. A 10-minute improvement in transit time would triple the potential market.

The transbay decline on AC Transit lines will be more than overcome by gain in feeder traffic to BARTD. Total adult riding on AC Transit will increase by 1975 to over 43 million passengers annually from the 1965 level of 35,700,000—a gain of 21%. Express services will decline materially, but the arterial routes altered to serve BARTD stations, as well as crosstown and feeder routes, are expected to rise by 36% and 229% respectively.

Under the recommended plan, more than half of AC Transit patronage in 1975 will be BARTD-related. 65% of crosstown and feeder route patronage will be to and from BARTD stations, as well as 56% of riders on East Bay arterial and express routes.

Recommended Muni Network—The Muni route system will be substantially altered by BARTD, although not to the same degree as AC Transit. Several other missions, in addition to coordination with BARTD, were sought in the Muni rerouting:

- Define other corridors for rapid transit development;
- Test over 50 requests for route extensions and other service changes submitted by various organizations and individuals;
- Develop other route changes unrelated to BARTD for improving the Muni system.

Four complete transit networks were developed and tested before arriving at a recommended plan of optimum transit usage for San Francisco. In each, some grade-separated service has been included in addition to BARTD. Present transit volumes in Richmond, Sunset and Twin Peaks corridors show a warranty for grade-separated service. As a result, rapid transit in a variety of forms—conventional rail operation, express bus on separate rights-of-way, high-speed streetcars in subway-surface operation, etc.—was evaluated.

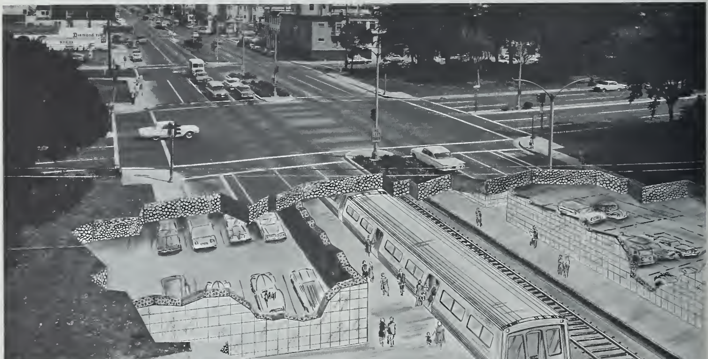
The recommended network (Plan D) provides for a four-prong system of rapid transit lines from the southern and western sections of the city to downtown San Francisco, supplemented by bus rapid service on present and committed freeways in the Bayview corridor. In addition, it includes 54 surface routes, with several new crosstown lines, others rerouted for connection to rapid transit, and some retained to accommodate intermediate travel.

Adult riding on Muni surface routes under the recommended plan is expected to reach 147 million annual users from the 1965 level of 126 million riders—a gain of 17%. 60% of this surface patronage in 1975 will be 'rapid related;' 29% to BARTD and 31% on connecting surface legs to other Muni rapid transit lines.

Further gains in transit use in San Francisco are expected from improved service by the proposed network of Muni Rapid lines. Passenger projections anticipate almost 200,000 riders daily, divided among Richmond Rapid (55%), Sunset Rapid (13%), Twin Peaks Rapid (10%) and Market Street (22%). Montgomery Street Station will be the heaviest on the system for all three Muni grade-separated routes, in addition to BARTD. From these several analyses, it is evident that the transportation hub of the entire Bay Area is centered at Market and Montgomery Streets.

This rail rapid transit network would serve nearly four-fifths of the city's total population. Approximately one-fifth will be within easy walking distance and another three-fifths will have short feeder bus access to rapid transit service connecting directly with the commercial/shopping/civic centers of downtown San Francisco.

Time savings on Muni Rapid routes would vary from eight to 18 minutes each way. The rapid transit running time would be under 14 minutes from the outer ends of all four lines to downtown San Francisco. This recommended plan, therefore, would bring 95% of


MUNI RAPID UNDER PARK PRESIDIO

the city's population within Mayor Shelley's goal of making San Francisco a 20-minute city, i.e., 20 minutes travel time from any outlying point to the downtown area.

Feeder Lines in New Service Area—Additional feeder service to BARTD has been considered in three peripheral sections of the NCTDP study area beyond the service territories of AC Transit and Muni—eastern Contra Costa County, southern Alameda County and northern San Mateo County.

The BARTD Concord line will extend 16 miles beyond present AC Transit territory in eastern Contra Costa County. A network of 11 bus routes has been designed to feed BARTD and provide local service. This recommended feeder network will afford service to population clusters within six to seven miles of the BARTD line. Beyond that, the added mileage expense and lack of patronage makes cost of such service prohibitive.

Southern Alameda County includes two BARTD stations—Union City and Fremont—which extend six miles below present AC Transit territory. A network of seven feeder routes has been designed for this portion of the BARTD service territory.

Northern San Mateo County will be served by the BARTD Daly City Station. This area now has eight bus routes, three operated by Greyhound Lines and five local routes by Northgate Transit Company. These lines, coordinated with BARTD, should fill the need for feeder bus service pending development of a comprehensive transit plan for San Mateo County by the West Bay Rapid Transit Authority.

FUTURE NEEDS—VEHICLES, PLANT & MANPOWER . . . Chapter 11

Eight out of 10 transit patrons in 1975 will either use a different bus route, or rapid transit train which they have not yet seen, to make the same journey as in 1965. This transformation will require more than just route configurations: substantial modification of vehicles, plant and manpower for both AC Transit and Muni will be involved.

Vehicular Requirements—AC Transit is an all-bus operation and will remain so for the foreseeable future. The redistribution of traffic with BARTD in operation will reduce its peak vehicle requirements by 35%. Allowing for school, special service and spares, a fleet of 500 coaches is projected for 1975.

Muni's vehicle needs are more difficult to assess, due not only to rapid transit and other route changes, but also its present equipment deficiencies and prospects for conversion. Two-thirds of trolley coaches will be eliminated, as result of curtailment of five such routes and conversion of four others to bus operation.

Peak vehicle needs for the three rapid transit lines will be 104 high-platform transit cars. Modern rapid transit vehicles with advanced styling and other traveling conveniences are recommended, comparable to proposed BARTD vehicles. After careful consideration, these were chosen over PCC-type and articulated streetcars, due to their superiority in greater capacity, proven experience and compatibility with structures of the existing Twin Peaks Tunnel and new Market Street Subway.

Five additional cable cars are needed; pains should be taken to assure that these are as antiquated as the rapid transit cars are modern, in keeping with the present cable car fleet.

Muni Modernization Program—Further improvements in Muni plant and facilities to achieve the recommended system for 1975 will involve major rehabilitation of existing shops and garages, and addition of new way and structures. A program of Muni modernization has been developed for (a) vehicles, (b) way and structures, (c) shops and garages, (d) cable car system, (e) power system, and (f) special facilities. Several alternatives for staging these capital additions, involving replacement of virtually every vehicle and facility in the present system, have been considered.

Foremost elements of the comprehensive transit plant will be the three additional rapid transit way and structures:

RICHMOND RAPID—A double-track rail tunnel with 12 stations under Post Street and Geary Boulevard, from Market and Montgomery Streets to 45th Avenue —a distance of 5.85 miles. The structure would also include provision for future BARTD connection to Marin County.

TWIN PEAKS RAPID—BARTD will construct the subway under Market Street with connections to the Twin Peaks Tunnel and extend that to St. Francis Circle. Extension of the line is recommended past the Stonestown Shopping Center to San Francisco State College and Parkmerced.

SUNSET CORRIDOR would be up-graded in two stages. Initially, the present Judah streetcar tunnel would be renovated, paved and lighted for express bus service. Thereafter, a new rail tunnel would be built between Market Street and 19th Avenue—a distance of 3.0 miles. This structure would be similar to the Twin Peaks and Richmond Subways in cross-section, with provision for further extension into the Sunset district at a future date.

Extensive rebuilding of Muni shop and garage facilities is required. Six new or rebuilt divisions are proposed at a capital cost of $17.3 million:

- Kirkland Division—New garage and office facilities;
- Ocean Division—New two-level storage and service facilities;
- Potrero Division—Convert existing trolley coach structure to motor coach service operation;
- Presidio Division—Improve existing trolley coach service accommodations and modernize Muni general offices;
- Automotive Overhaul Shop—New two-story structure for motor overhaul, body and paint shops, etc.;
- Rail Service Facility—An underground installation with storage yard, servicing, repair and overhaul facilities and shop offices, adjacent to Twin Peaks Subway for rapid transit maintenance.

Modification of the existing power system—including new substations and power distribution facilities—will be needed to accommodate the rapid transit and remaining trolley coach operation. And certain transit furniture items—speedwalks, minibuses, traffic priorities, bus shelters—are recommended also for passenger convenience and improvement of operating efficiency.

This comprehensive program of Muni transit improvements is estimated to aggregate $310 million to $395 million, depending upon which of several alternatives is finally chosen. A first-phase program, aggregating $96.5 million, was the subject of public referendum in November, 1966. The bond issue received approval of 58% of the voters, indicating a favorable disposition towards the program but short of the two-thirds endorsement required under San Francisco charter.

Manpower Requirements—AC Transit's manpower requirements in 1975 will be slightly reduced. The total work force is estimated to decline from 1,416 in 1965 to 1,371 in 1975, with the reduction taking place in maintenance and salaried forces primarily.

On the other hand, a 33% increase in the Muni work force is projected for 1975. Operators, maintenance force and office workers will increase 18-20%, in addition to which 400 rapid transit employees will be needed. Matching this, Muni service—including rapid transit—is projected to increase 45%. Thus, under the coordinated system, a higher volume of service will be provided by a lesser increase in manpower and vehicles, yielding greater productivity as well as a more attractive transit system.

FARES AND PASSENGER REVENUE IN 1975 . . . Chapter 12

Various fare proposals were considered from the standpoints of public acceptance and policy considerations, then tested for their influence upon traffic generation and revenue production. With several choices on each system, as well as inter-system alternatives, the initial problem was to narrow the range, then determine the effectiveness of fare components upon passengers and revenue. Following this, the cost side of the equation was introduced and the iterative process of revenue and cost projections repeated until reasonable balance was achieved.

Four fare plans were considered for BARTD, including the 'Composite Report' proposal. While all four have the same minimum and maximum fare—25¢ and $1.00, respectively—the differences in block rates for trips of intermediate length were substantial. Two alternatives were studied for AC Transit, present fares and a straight 25¢ rate, both predicated on retention of existing zone patterns. Machine tests for Muni fares included three alternatives—the present 15¢ fare, a 20¢ and 25¢ adult rate for surface rides, with a 25¢ Muni Rapid fare.

In addition to these, combination fares for feeder trips via Muni or AC Transit surface vehicles to BARTD were considered at 10¢ and 12½¢ per one-way feeder ride.

In deriving passenger revenue under alternative fare plans, careful consideration was given to sub-modal split—the distribution of riders between rapid transit and surface lines—and the effect of fare differential upon it. A family of fare/time differential diversion curves, stratified by fare differences between rapid and surface transit, was developed for internal redistribution of traffic between rapid and surface routes, without affecting the aggregate volume of transit riding.

The next step was to determine the impact of fare increase upon transit volumes under the several fare plans. Universally, fare increases in the range herein considered have produced revenue gains for the transit systems involved. But it is also a universal phenomenon that some passenger riding is lost due to each fare increase, no matter how nominal.

In the light of past experience in San Francisco and elsewhere, a shrinkage ratio of 0.20 was estimated for the Bay Area with fare increases up to 25¢ or less. This would produce a reduction of 6.7% in Muni surface patronage under a 20¢ fare and 13.3% patronage loss under a 25¢ fare. A lower shrinkage ratio is anticipated on BARTD and Muni Rapid because of the superior quality of service and passenger amenities on rapid transit compared to existing transit forms in the Bay Area. Particularly when rapid transit service is being introduced, higher fares are expected to have an inverse effect upon riding, but less than the passenger loss would be on existing service.

Machine Run V was designed to test the productivity of the lowest level of fares meriting consideration under prevailing financial requirements. It included the BARTD fares outlined in the Composite Report (Plan B-1), a 20¢ surface and 25¢ rapid transit fare for Muni (Plan M-2) and the present 25¢ cash and 20¢ token fare for AC Transit (Plan A-1), with 10¢ feeder fares from either Muni or AC Transit to BARTD. Results of this analysis indicated that the three systems can be expected to accommodate 331 million revenue passengers in 1975, with operating revenue of almost $62.5 million as follows:

System	Fare Plan	Revenue Passengers	Passenger & Advertising Revenue
BARTD	B-1	57,647,315	$20,965,748
Muni Rapid	M-2	42,808,241	10,498,212
Muni Surface	M-2	169,082,425	21,317,970
Muni Total	M-2	211,890,666	$31,816,182
AC Transit	A-1	61,233,949	$ 9,661,666
TOTAL		330,771,930	$62,443,596

Machine Run VI was designed to maximize revenue potential within the range of fares prevailing among other Bay Area commutation carriers—Greyhound and Southern Pacific Railroad—and the industry generally. It consisted of a 25¢ to $1.00 fare scale for BARTD with 50¢ minimum for transbay trips (Plan B-4), 25¢ Muni fare on surface and subway lines (Plan M-3) and 25¢ basic fare on AC Transit (Plan A-2), with feeder fare to BARTD of 25¢ for the round trip on either Muni or AC Transit. In other words, the local one-zone surface fare would be 25¢ on both sides of the Bay, with half fare (12½¢ for each one-way surface leg) for feeder trips to and from BARTD. This machine run produced an expectancy of 325.5 million patrons and passenger & advertising revenue of $71.6 million, subdivided among the three systems as follows:

System	Fare Plan	Revenue Passengers	Passenger & Advertising Revenue
BARTD	B-4	56,552,832	$25,723,433
Muni Rapid	M-3	44,634,798	11,052,428
Muni Surface	M-3	163,862,047	24,253,232
Muni Total	M-3	208,496,845	$35,305,660
AC Transit	A-2	60,414,714	$10,607,791
TOTAL		325,464,391	$71,636,884

Serious consideration has been given to the elements involved in devising an equitable formula for sharing the joint fare discount among affected transit systems. The amount to which a surface system is entitled for carrying a joint fare rider could be developed in relation to the length of ride and fare charged for non-feeder trips on that particular local system. An alternate approach would relate the amount to be received by the local system for carrying the feeder line passengers to the average cost per passenger on the entire surface operation. Another fundamental approach would be to relate the average length of ride for feeder passengers on a particular local system to the length of ride on the rapid transit line to which feeder passengers are delivered.

There are other relevant factors—proportion of peak hour patronage, proposed level of fares, comparative length of feeder trips in relation to line haul—some of which are counterbalancing considerations. A wide variety of formulae can be devised provided there is agreement among the carriers on objectives. In this instance, the three transportation agencies will have to give more detailed study to policy on feeder service and its several complexities before a formula can be evolved. To a considerable degree, the final arrangement will depend upon how much feeder surface operation to BARTD is required and how much is realized in fare box revenue in the aggregate from that service.

A series of six discount proposals were analyzed for joint fare reduction, ranging from 5¢ to 12½¢ on surface feeders, in relation to revenue yield to surface and rapid transit systems.

Promotional Fares—A variety of promotional fares was also considered to augment those prevailing on AC Transit and Muni. Most significant among these is a reduced rate for multiple-trip ticket buyers. Eleven rides for the price of 10 is proposed on cash fares above 50¢. It is estimated that this discount would be used by 55% of patrons whose cash fare is at the 55¢-60¢ level, with higher proportions of discount sales for longer journeys up to 85% usage in the 90¢-$1.00 fare bracket. Off-peak promotional fares are also recommended for BARTD.

Station Parking Charges—Moderate fees for parking at BARTD stations are also proposed as a revenue supplement and also to prevent usurpation of space by others. Another consideration supporting a parking charge is the need for added revenue to offset feeder bus subsidies. Feeder routes to outlying stations will be at sufficient competitive disadvantage with autos in speed differences, without an added handicap of free parking. A 25¢ charge is recommended for all-day parking at BARTD stations.

An alternative would be to vary parking charges among BARTD stations according to supply and demand. Where available space exceeds demand, a substantial number of free stalls could be made available. At other locations, where the demand exceeds supply, a 25¢ charge would be made for most spaces and a preferential rate of 35¢ to 50¢ for parking stalls nearest to the station. This arrangement would maximize the revenue yield from the parking facility, while at the same time inducing some patrons to drive to alternate stations where excess space is available.

OPERATING RESULTS IN 1975 . . . Chapter 13

To evaluate the proposed fare structures, singly and in combination, it was necessary to determine their sufficiency in meeting projected operating expenses. This was accomplished by determining the amount of service required in each operation, then developing the cost of that service.

Future service levels were based from present quantity standards for each class of service. For example, if a route is now serviced at 300 vehicle-miles per 1,000 revenue passengers carried, and no substantial change in route function is made, future annual mileage was forecast at the same level of service. Modifications were made where bus arterial routes will be converted to rapid transit feeder or to crosstown lines. After determining annual miles to be operated on each route, vehicle hours were derived through use of speeds computed for each route in the network coding procedure.

A modification of the cost allocation models previously developed was devised for predicting future route operating costs. Sensitivity tests showed only minor deviation between three-variable and four-variable equations for cost allocation, less than the range of error inherent in the forecasting process. As a result, three-variable formulas were devised for forecasting costs of each class of future surface operation based upon vehicle miles, vehicle hours and passenger revenue.

Future cost/revenue relationships were developed initially for both surface systems, then extended to BARTD and Muni Rapid, to arrive at projected operating results for each system in 1975.

Muni surface revenues are projected at 73.0¢ per mile, with unit costs estimated at $1.18. Therefore, the surface lines' excess of cost over revenue in 1975 is anticipated at 45¢ per mile. This compares with a deficit of 31¢ per mile on the Muni system in fiscal 1965 and a loss of 59¢ per mile on Muni feeder lines. A major factor contributing to this operating loss is the high proportion of prospective traffic in low-fare feeder service. Approximately 60% of adult riders on Muni surface in 1975 will be making reduced-rate feeder trips to Muni Rapid or BARTD under the recommended plan.

Similarly, 57% of adult passengers on AC Transit lines in 1975 are expected to be riding buses to and from BARTD. Hence, AC Transit will receive a full fare from only 43% of adult patrons. Revenue per mile is projected at 45.2¢ in relation to unit operating costs of 80.8¢. Therefore, the AC Transit operation is expected to lose 35.6¢ per mile in 1975, prior to adjustment for discount sharing with BARTD and allowance for children and student fares. In 1965, feeder routes of AC Transit lost 36.6¢ per mile. Prospective results of operation for the entire system in 1975—when it will be essentially a feeder operation to BARTD—are anticipated to be substantially similar.

Rapid Transit Operating Costs—Future service levels on BARTD and the Muni Rapid system were determined from estimated passenger volumes at maximum load points on each line. An analysis then was made of rapid transit operating costs among six systems in North America, from which the cost factors at Chicago, Philadelphia and Cleveland were segregated as representing the most appropriate gamut for estimating future costs on BARTD and Muni Rapid. Four

categories of direct operating expense were analyzed: conducting transportation, maintenance of rolling stock, maintenance of way and structures, and power costs. Then, general and administrative expenses were added to provide the appropriate overall units.

Operating costs on these three rapid transit systems totalled 72.53¢ per mile at 1965 cost levels. Updating this to 1967 and making provision for differences in wage levels and projected operating speeds, an estimated cost of 80¢ per car mile for the Muni Rapid system was derived, excluding depreciation, taxes and debt service.

Similar analyses of prevailing differences between the rapid transit gamut and BARTD produced an estimated cost of 58¢ per car mile for the latter operation. BARTD will have the advantage of automation to reduce manpower requirements. Furthermore, its operating speed will average over 40 m.p.h. compared to speeds in other systems of 20-25 m.p.h.

Pro Forma Operating Results—With a coordinated feeder network and recommended fare plan (B-4), BARTD is expected to generate revenue of $27,723,433 in 1975. Service on the BARTD system will aggregate 23,442,000 miles; at a unit cost of 58¢, operating expense is estimated at $13,596,360. After allowing for discount-sharing payments to Muni and AC Transit of $1,538,057, as developed under Plan F, the estimated net operating revenue remaining would be $10,589,016. This is the amount available for debt service on rolling stock, depreciation, reimbursement of construction costs and appropriate reserves.

The principal item to be supported out of net operating revenue of BARTD is the cost of rolling equipment. BARTD's financing plan is based on equipment purchases made with bonds secured by operating revenues of the system. At a prospective car cost of $68 million, debt service requirements for these revenue bonds have been projected at $6,613,000, assuming a coupon rate of 4¾% and 25-year amortization. Therefore, the net operating revenue projected would provide 160% coverage for debt service on these revenue bonds, with the excess available for repayment of transbay tube approach costs.

With its recommended fare plan M-3 and the coordinated surface and rapid transit network previously outlined, Muni is expected to have an operating deficit in 1975 of nearly $7 million, as shown below.

Muni Rapid is expected to be a profitable operation producing net income of more than $4¾ million in 1975. Offsetting this will be the loss on Muni surface lines exceeding $12-2/3 million, part of which is chargeable to the Muni Rapid, since it includes feeder operations at reduced fares.

The net result after allowance for discount sharing from BARTD is a prospective annual loss of $6,947,080 in 1975. Similar calculations for the 20¢ fare plan on Muni surface lines—Plan M-2—produced $3,600,000 less passenger revenue and $500,000 greater operating expense by reason of increased mileage, yielding a projected deficit of more than $11 million. In the light of this, and recommended fares on the other systems, it appears logical to charge a basic fare of 25¢ on all three Bay Area systems.

This projected deficit of $7 million is slightly under actual deficits on Muni in the past few years.

Similar projections were made for AC Transit's reduced operation in 1975 based upon its recommended Route Plan E, Fare Plan A-2 and Discount-sharing Plan F, coordinated with the cost allocation model previously described. 1975 projections indicate operating revenue of $11,973,411 and operating expenses of $17,055,659, leaving a deficit of slightly over $5 million. This would require more than twice the tax proceeds which AC Transit has received annually in 1965 and 1966.

Combining the three recommended networks, transit operations are expected to expand to a gross figure of $72,736,900 by 1975. Expenses of the three systems will exceed this slightly; sum of the three operating cost estimates aggregates $74,177,200. This will leave a net areawide transit deficit of $1,440,300, which is within the acceptance level of communities on both sides of the Bay in recent years.

Perhaps the most significant prospect is the projected increase in transit revenue for the Bay Area in the decade 1965 to 1975. Passenger and advertising revenue of the two existing systems aggregated $33,089,000 in fiscal 1965. This is expected to rise to $72,736,900 ten years later—a projected expansion of 120%. Part of this is due to fare increase and the rest to an overall capital investment of $1.5 billion to provide the most advanced areawide transit system in the world. If this should appear optimistic, the promise is implicit in the pulling power of rapid transit, rather than any liberality in forecasting assumptions.

FARE COLLECTION . . . Chapter 14

BARTD will carry 56.5 million passengers in 1975, each of whom will pass through an entrance and exit BARTD station—a total of 113 million turnstile passes. Nearly two-thirds of the access trips to and from BARTD—74.4 million rides annually—will be made on buses and trolley coaches. The need for a convenient and efficient collection system for joint system riders is evident therefore.

Fundamentally, the problem is to develop a collection method involving two diverse manually-collected systems—Muni's flat fare and AC Transit's zone fare—and a fully automated collection plan on BARTD for a fare structure based on varying station-to-station rates. Fares on the Muni and AC Transit systems are collected on a pay-enter basis. BARTD plans a fully automated system, based upon stored value or stored trip tickets which are magnetically encoded and inserted by passengers in entrance and exit turnstiles.

	Muni Rapid	Muni Surface Lines	Muni System
Passenger and Advertising Revenue	$11,052,428	$24,553,232	$35,605,660
Discount-Sharing Payment from BARTD	—	—	972,437
Total Revenue	$11,052,428	$24,553,232	$36,578,097
Operating Expenses	$ 6,292,400	$37,232,777	$43,525,177
Profit (Deficit)	$ 4,760,028	($12,679,545)	($ 6,947,080)

FMC Corporation made a detailed analysis of existing fare collection techniques in the United States and Europe and outlined six alternative systems for this particular adaptation. Most of these required one or more machines on surface vehicles compatible with the proposed vending machines and registering turnstiles at BARTD stations. Considerable attention was devoted to these FMC suggestions and to other arrangements for joint fare collection in sessions with operating managers; it became evident, however, that the alternatives to be finally considered would be governed by two facts of overriding importance:

(1) The automated BARTD system will prohibit manual or visual elements insofar as BARTD legs of joint trips are concerned.

(2) Muni and AC Transit have a pronounced preference for a method which will not require special equipment on surface vehicles.

On this restricted basis, three alternative schemes were prepared.

Collection Plan A—The first arrangement provides that passengers would pay their BARTD and surface feeder rides—in one transaction. A two-part ticket would be sold by the surface line operator—one stub for the feeder trip and the other a 25¢ ticket on BARTD. For a three-vehicle journey including BARTD, the passenger would pay the combination two-vehicle fare and secure a free surface transfer, retaining this for use in the second surface ride.

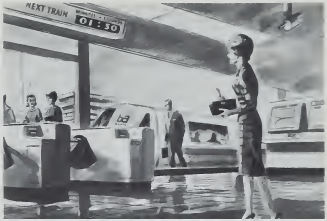
This proposal has several advantages: it provides for a discount on all one-way combination rides, is adjustable to various fare combinations and compatible with BARTD automated collection equipment. The disadvantages of this proposal arise in dealing with commutation tickets and other special fare groups such as students. Muni and AC Transit surface operators would have to carry stocks of separate joint tickets for adults, children, commuters, students, off-peak riders, etc. Similarly, money from the sale of joint tickets would have to be collected and accounted for by surface operators, requiring a system of inter-line accounting.

Under any joint fare ticket plan, the passenger would purchase a minimum fare ride on both the surface and BARTD services. It would be impossible, as a practical matter, to design a joint ticket covering the large number of fare possibilities on BARTD in surface vehicle transactions.

Collection Plan B—This scheme was designed to permit joint fares to be handled separately in each direction, granting a discount in one direction only. The patron would pay the regular fare on the surface trip to a BARTD station, as well as the prescribed BARTD fare. On his return, he would deposit 5¢ (or other amount below regular surface fare) in the vending machine, and receive a transfer entitling him to a surface ride. A passenger using two surface legs, before and after a BARTD journey, would be handled by a transfer plan.

The only special equipment involved would be transfer machines and validators within the paid area of BARTD stations. These would be coordinated with turnstiles to prevent passengers from buying more than one surface feeder transfer at the discount rate.

THE PRINCIPAL ADVANTAGE OF PLAN B is its simplicity. Everyone traveling to BARTD would pay the regular surface fare. Those leaving BARTD and wishing to use surface transportation would be accommodated by a simple procedure in daily use on many transit systems.



Nothing would be added to the duties of surface operators. The plan is extremely simple not only from the standpoint of collection but accounting as well. With the payment of the 5¢ deposit in the transfer-issuing machine to the surface system, both Muni and AC Transit would receive 30¢ for the round trip taken in conjunction with BARTD. Thus, if BARTD were to turn over the moneys collected from vending machines at its stations, the entire transaction would be closed at this point.

MAJOR DISADVANTAGE OF COLLECTION PLAN B is the imbalance caused by unequal fares for the same trip in two directions. The passenger who rides surface lines only to BARTD obtains no discount. On the other hand, the individual reaching BARTD by some other mode, then using the surface line when leaving BARTD on his return trip, pays only a 5¢ fare. This unbalanced fare to and from BARTD would have significant effects where alternate surface transit routes are available. Some combination rides would be diverted entirely to surface lines in the direction where no discount is provided. In the return direction, the same passenger would choose the joint ride involving BARTD, realizing both the time savings and the added discount.

Under normal conditions, 95-98% of BARTD-related patrons will be round-trip riders. This collection plan, however, is likely to distort this proportion.

Collection Plan C—This third fare collection plan is designed to function independently of the BARTD collection procedure. For a Muni-BARTD or AC-BARTD round trip, the patron would pay the regular surface fare and receive a BARTD exchange ticket, good for the return surface ride without added charge, after validation within the BARTD station. The procedure would work in reverse for a BARTD-Muni or BARTD-AC round trip; the passenger would obtain the exchange ticket within the BARTD paid area by depositing part or all of the surface fare, then use that for the outbound trip from BARTD while getting a transfer for the surface trip returning to that station. Similar adaptations would be made for Muni-BARTD-Muni or AC-BARTD-AC round trips.

Plan C is not as simple in operation as Plan B but it would be easily understood by passengers, no burden to operators and tight accountingwise. Plan C does not permit a one-way discount; this defect, however, would apply to only 2-5% of BARTD-related riders on Muni and AC Transit.

UNLESS THE THREE SYSTEMS INVOLVED decide that every joint passenger must be granted the opportunity for discount on a one-way basis, some variation of Plan C appears to be the most acceptable arrangement.

SUMMARY OF TRANSIT RECOMMENDATIONS FOR 1975

. . . Chapter 15

The recommended transit network for the Bay Area consists of:

- BARTD—A three-prong rapid transit layout in the East Bay converging to a transbay link running diagonally across San Francisco, with 33 stations—25 in the East Bay and eight on the San Francisco side.
- MUNI—A fan-shaped feeder-trunk layout of surface and rapid transit routes converging upon the CBD as a hub. In addition to BARTD Mission line, three rapid transit trunk lines are proposed—Richmond Rapid, Sunset Rapid and Twin Peaks Rapid. Seventeen existing Muni surface routes would be modified to feed Muni Rapid lines, 12 rerouted to become BARTD feeders, 13 other Muni routes would remain unchanged and 12 would be modified for service improvements unrelated to rapid transit.
- AC TRANSIT—A BARTD-oriented network of 48 basic routes including six transbay and two East Bay express lines, one special route to Treasure Island, 13 arterials, and 26 crosstown and feeder routes.

In addition, 18 new feeder routes are proposed, 11 in eastern Contra Costa County and seven in southern Alameda County, beyond service limits of existing AC Transit operations.

The numerous route changes should be geared to four stages of BARTD operation: (1) initial service between MacArthur Station in north Oakland and South Hayward; (2) transbay service from Concord to Daly City; (3) BARTD extension between Richmond and MacArthur Stations; and (4) operation from South Hayward to Fremont. Further, some Muni changes involving trolley coaches should be accelerated as part of the Market Street rehabilitation program.

PROJECTED FLEET REQUIREMENTS for Muni in 1975 aggregate 706 vehicles consisting of 115 rapid transit cars, 450 motor coaches, 110 trolley coaches and 31 cable cars. This will be a 28% reduction in present fleet, substituting vehicles of greater capacity, speed and utility. The AC Transit system is projected as an all-bus operation of 500 coaches in 1975.

SHOP AND GARAGE FACILITIES—Extensive rehabilitation of Muni maintenance facilities will include four new garage, service and office buildings at major division points. Five new power substations and power distribution facilities will also be needed.

AC Transit will require some capital expenditures for improved shop and garage facilities, particularly to replace the BARTD land-taking at its Richmond Division. For the most part, however, this system's plant facilities are adequate.

OTHER MUNI CAPITAL FACILITIES—Further plant improvements are needed for Muni modernization:

- Cable Car Routes—Improvements to way and structures and equipment including partial re-railing, alarms, signals and braking systems for increased safety and efficiency;
- Cable Car Barn—Restoration including a visitors' gallery, museum, and displays to enhance its historical value;
- Power System—Solid state rectifier equipment in Twin Peaks substation and new substations for rapid transit facilities;
- Radio-telemetry Control—Two-way radio system for communicating with rapid transit and surface vehicles;

- Park-ride—An underground garage at Park Presidio to intercept Marin motorists and switch them to Richmond Rapid;
- Minibus—Side-loading vehicles for short downtown routes;
- Speedwalks—Electric walkways for passenger distribution at Market Street Rapid stations;
- Traffic Priorities—Bus actuated traffic signals on arterial routes, no-parking restrictions, lengthened bus stops and other priorities for speeding transit service;
- Bus Shelters—Attractive shelters with telephone information hookup at heavy street-loading points.

Recommended Fare Structures—New fare proposals for each of the three Bay Area systems and for combinations among them are recommended as offering the optimum balance between revenue production to support operations and attractiveness in drawing passengers to the systems:

BARTD FARES—A range of station-to-station adult fares, between 25¢ and $1.00, according to the following formula:

First 4 miles	25¢
4 to 10 miles	25¢ + 4¢/mile
10 to 15 miles	50¢ + 3¢/mile
Over 15 miles	65¢ + 2¢/mile
Maximum Fare	$1.00
Transbay	Mileage + 4 miles with 50¢ minimum
Peninsula	25¢ within San Francisco 35¢ maximum
Multiple-ride Tickets	11 rides for the price of 10, applicable to cash fares above 50¢
Sunday-holiday Pass	75¢ for unlimited rides on Peninsula
Sunday-holiday Pass	$1.00 for unlimited rides on East Bay lines
Station Parking	25¢ all-day at BARTD stations

AC TRANSIT FARES—Recommended fares for the modified AC Transit system include the following:

Adult Single Zone Cash Fare	25¢
Multiple Zone Increments	Same as present
Transfers	Free
Transbay Fares	Same as present
Surface Feeder to BARTD	25¢/Round Trip
Students and Children	15¢
Sunday-holiday Pass	75¢ for unlimited rides in the East Bay area

MUNI FARES—It is proposed that the Muni base fare be brought to the level of the other two systems:

Adult Fare	25¢
Surface Transfers	Free
Adult Combination Surface-Muni Rapid Fare	30¢
Surface Feeder to BARTD	25¢/Round Trip
Students and Children	15¢
Sunday-holiday Pass	75¢ for unlimited rides over entire system

COMBINATION FARES—As indicated, feeder trips to BARTD are recommended at 25¢ for the round trip so that the combination fare would be the full BARTD amount plus 12½¢ for the feeder journey in each direction.

Projected Results of Operations in 1975—The recommended transit plan for the three Bay Area systems is projected to produce an overall gain of 67% in revenue passengers by 1975. This increase is overstated by reason of the greater proportion of two-system journeys and feeder-rapid transit trips being tallied separately. The expected gain after adjusting for these will be closer to 30%—still an impressive gain for this 10-year period.

Passenger revenue is expected to rise 120%—one of the fastest growth expectations among major industries or services in the Bay Area. This will be the product of two items—more transit traffic and higher fares.

Operating costs are projected to rise 75%, from $43 million to $74 million. Deficit operations will continue at Muni and AC Transit. It is noteworthy, however, that the three systems in combination are expected to be much closer to a break-even point in 1975 than the two existing operations, Muni and AC Transit, have been in recent years.

PROJECTED 1975 RESULTS OF OPERATIONS

Three Bay Area Transit Systems

	1965	1975	% Change
Revenue Passengers			
BARTD	—	56,552,832	—
Muni	141,724,908	208,496,845	+ 47.1%
AC Transit	52,905,464	60,414,714	+ 14.2
Total	194,630,372	325,464,391	+ 67.2%
Passenger & Advertising Revenues			
BARTD	—	$ 25,723,433	—
Muni	$ 19,820,932	35,605,660	+ 79.6%
AC Transit	13,268,079	11,407,791	— 14.0
Total	$ 33,089,011	$ 72,736,884	+119.8%
Cost of Operations			
BARTD	—	$ 13,596,360	—
Muni	$ 27,966,377	43,525,177	+ 55.6%
AC Transit	14,827,112	17,055,659	+ 15.0
Total	$ 42,793,489	$ 74,177,196	+ 73.3%
Net Revenues			
BARTD	—	$ 10,589,016	—
Muni	$ —7,991,711	—6,947,080	+ 13.1%
AC Transit	—1,463,421	—5,082,248	—247.3
Total	$ —9,455,132	$ —1,440,312	+ 84.8%

PROMOTION OF TRANSIT SERVICE . . . Chapter 16

Effective promotion of transportation services involves the strategy for integrating four major marketing elements of surface and rapid transit systems—traffic analysis, service standards, fare policy and communication. The latter includes conventional informational services, bulletins, press releases, etc. It should be evident that the substance of informational services is generated within the service and fare policies which transit management seeks to impress upon the travel market. Since these merchandising elements are interacting, they should be considered as an integrated group rather than as separate and remotely related policy determinations.

PREVAILING DIFFERENCES among Bay Area communities reflect a variation in thinking on the function of transit. Some advocates sponsor transit out of disenchantment with costly freeways which disrupt neighborhood amenities in established urban areas. Other urban planners see transit as a prospective control device for regulating the physical and social problems of slum and blighted areas. Suburban developers are more interested in the influence of rapid transit on outlying real estate values. Among these multi-purpose goals, the three public transportation agencies are being developed under varying restraints with little relation to one another and only incidental consideration of their collateral effects upon each other or upon future community development. A reasonable degree of working cooperation prevails. But there is need for a higher order of coordination; the need persists for an orderly and economical program of urban transportation development—a system analysis that will not only provide an accurate perspective of needs and solutions, but one which will promote public acceptance of improvement programs. The transportation objectives for the Bay Area may be consolidated to embrace these influences:

- Attraction of a major share of peak-hour traffic to and from the San Francisco and Oakland business districts to relieve rush-hour traffic congestion on Bay bridges and other congested arteries;
- Reduction of all-day parking demands in business areas to provide more space for shoppers and other optional auto travelers in high-density areas;
- Mobility of pedestrian circulation in the business, shopping and civic centers of San Francisco, as well as the high density core areas of other Bay Area cities;
- Promotion of population growth in suburban residential sections;
- Controlled development of land use activities—residential, commercial, industrial and recreational—in accordance with local community desires; and
- Renewal and redevelopment of blighted areas.

FIVE PRINCIPLES ARE OUTLINED as guidelines for planning and operating each transit system in keeping with the economic and social interests of Bay Area residents and long-range goals for community development.

(1) Regional considerations, unrestrained by city limits, should be the basis for transportation planning;
(2) Close coordination of schedules, fares and other service matters is paramount;
(3) Transit market analysis should include more thorough understanding of auto travel and the influence of trip schedules—toll bridges, parking facilities, traffic control devices, etc.;
(4) The interrelationship between transportation planning and land activity should be more thoroughly explored;
(5) 'Cost-effectiveness' analysis should be the governing basis for significant decisions on metropolitan transportation.

To coordinate properly transportation planning with land development, population growth and economic expansion in the metropolitan area, a continuing forum should be established to apply the foregoing principles. A compact is proposed among Muni, AC Transit and BARTD for a dual purpose:

- To provide a forum for review of transportation policies and practices which have some interaction with the other transit agencies;
- To administer the joint promotional efforts which will be handled more effectively on a coordinated basis. This compact would be a successor to NCTDP and carry forward its organization and study recommendations. It would program future transportation developments, establish priorities and review procedures, including a system for keeping track of progress toward interim goals. Further, the compact would determine a budget for promotional services to be accomplished jointly, the formulas for which would be a function of joint fare allocation. A portion of the joint fares is suggested for transit promotion as a convenient means of apportioning costs and one which will have reasonable assurance of program continuity.

A coordinating committee has been set up by the three agencies for implementing the recommendations in this transit demonstration program.

Joint Promotional Services—Joint handling of certain basic informational services appears desirable to insure coordinated trip information to passengers. The three systems may retrain personnel to coordinate passenger activities, the same as airlines handle joint bookings; or, they could be integrated for certain passenger-handling functions, while retaining their corporate individuality, similar to operating units of the Trailways Bus system. Items to be considered for joint administration include:

Computerized Informational Service
Telephone Information Exchange
Service Schedules
Time Table Preparation and Distribution
Maintenance of Schedules
Fare Collection Practices
Auditing of Joint Fares
Accident Prevention Programs
Handling of Complaints
Employee Courtesy Programs
Tie-in Arrangements with Merchants
Special Services Promotion—Football Games, Conventions, Special Party Services, etc.
Off-Peak Trip Promotions, including Shopper Specials and Weekend Tours
Advertising
Tours of Transit Facilities
Demonstration Projects with Federal Assistance
Reduced Fare Experiments

THE FINAL CONSIDERATION in developing promotional policies is adoption of an appropriate set of yardsticks for measuring the overall effectiveness of transportation service. It is not enough to determine the profitability or cost-revenue relationship for each system, although this is a significant measure. Prevailing fiscal/political patterns among transit systems in the Bay Area reflect an interest in more comprehensive transportation barometers.

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